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SOME UNSETTLED PROBLEMS OF IRRIGATION

Shaler called the Cordilleran area, comprising the western third of the United States, the "curse of the Continent". West of the hundredth meridian, precipitation, except for certain favored sections, is insufficient for agriculture or for forest growth, and pasturage can be reckoned on for the spring and early summer only. From the mesas and foothills of the Rockies to the western slope of the Sierras, arid or semi-arid conditions prevail. The average annual rainfall varies from two inches in the deserts of the southwest to twenty inches on the Great Plains, but nowhere except on the north Pacific coast does it furnish a reliance for the farmer. On the western slopes of the mountain ranges, where the moisture-laden winds of the Pacific ascend to colder altitudes, there is considerable rain. The precipitation of autumn and winter is held in vast beds of snow and ice until the fervid suns of May and June release the flow. Then springs and torrents rush down to the lowlands, the rivers overflow their banks, and the valleys are flooded. How to conserve this excess water to serve the needs of summer-grown crops is the problem of arid America.

The first Americans who attempted to farm the desert were the pioneers of the Mormon migration. Brigham Young and the one hundred and forty devoted saints who followed his lead across the Wasatch Mountains to the new Zion on the mesa above Great Salt Lake, had no knowledge of irrigation; but agriculture was a *sine qua non* to a settlement so remote from civilization. Within two hours of their arrival they began to plow for a belated planting. "We found the land so dry", wrote Lorenzo Snow, "that to plow it was impossible, and in attempting to do so some of the plow beams were broken. We therefore had to distribute the water over the land before it could be broken." The simple device worked satisfactorily and was used thereafter, not only to soften the soil but to water the crops. The damming

of City Creek marked the beginning of irrigation in the Great Basin. Thereafter water supply was regarded even more than character of soil and means of transportation in determining the location of the successive "stakes" planted in the wilderness. Irrigating works were built, as were roads and bridges and saw-mills, by coöperative effort, each colonist contributing labor or material or money as he best could. New and struggling communities were not infrequently financed by the Church, stock being taken in exchange for funds advanced. The Mormon communities have now some six million acres under irrigation in the arid West and are producing wheat and alfalfa, sugar beets, peaches, cherries, and strawberries, out of all proportion to their ratio in the agricultural population of the United States.

Meantime the American pioneers in California were profiting by the irrigating experience of their Spanish predecessors. Dr. John Marsh, a Yankee and a Harvard graduate, secured a Spanish grant to a good square mile of land at the foot of Mt. Diablo and set about its cultivation with a zeal that soon made him one of the wealthiest landowners in the province. His orchards and vineyards and irrigated fields were the marvel of the *hijos del pais*. Sutter's ranch on American Fork was an equally convincing demonstration of what brains could do by adding water to the soil and climate of California. Water rights were free as air and every *ranchero* used the streams that the winter rains sent across the lowlands, according to his own convenience. Only in the pueblos, San José and Los Angeles, was there endeavor to treat the scant supply as a common property to be developed by the building of dams and ditches under the direction of the public authorities. The advent of the gold seekers made heavy demands upon the water resources of the Sierras. Running water was a prime necessity in placer mining, the new market afforded by the mining communities induced a far more extensive agriculture, and water rights became, for the first time, a matter of serious concern. The water needed to operate the sluices and long toms had to be conducted to the diggings in flumes, sometimes many miles in length and representing a considerable investment of labor and capital. Mining custom, which the California Legislature formulated into law, established the principle of "first come first served". A notice posted at the point of diversion, stating date of posting and the amount of water to be taken out, constituted a claim to a specified number of miners' inches.

The law required that the claim should be registered with the county officer within sixty days of the posting, and the courts later decided that the claimant must prove that the construction of ditches, canals or flumes had been undertaken immediately and prosecuted with diligence, and that the water drawn off was being put to a beneficial use. Notwithstanding these precautions, the miners' custom, notably when applied to agricultural districts, gave rise to strife and uncertainties that seriously handicapped industrial development. It had become evident that land with no assured water supply was of little value for agriculture. The streams that might be utilized within the resources of individual ranchmen were soon monopolized, and works of greater cost were needed to construct diversion dams, build main canals, and set up pumping machinery for the irrigation of the thousands of acres of fertile land that lay back from the water courses. In the hope of encouraging the development of the Great Valley between the Sierras and the Coast Range, a region all untouched by the Spanish régime, the Legislature (1862) passed an act authorizing the incorporation of canal companies and the construction of canals "for the transportation of passengers and freights, or for the purpose of irrigation and water power, or for the conveyance of water for mining or manufacturing purposes, or for all of such purposes". Under this liberal enactment, several irrigation companies were organized on the basis of claims to the flow of the San Joaquin and its tributary rivers.

The common law doctrine of riparian rights was adopted by the courts of California in the early years of American occupation with no question as to its applicability to the new conditions. Practice vested in the adjacent landowner not only right to a continuous and undiminished flow, but to diversion for his own use and also for sale to agriculturists less fortunately situated. The effect was to give an extraordinary advantage to first comers and to speculators in this most valuable of natural resources. Subsequent cultivators, men who were proposing to convert cattle ranches and wheat fields into orchards and vegetable gardens, were obliged to be content with what was left or to defend their secondary claims by force. Appeal to the courts involved long and costly suits with inconclusive results, since the process of adjudication must be gone over whenever a new claimant appeared or an old claim was revived or extended. Agricultural enterprise in California is still retarded by the uncertainty of water

rights and the heavy costs of litigation. Any one of the tens and hundreds of appropriators along a single stream may bring suit to enlarge his share, and the law offers no remedy to the revival of old disputes. Often the small farmer cannot afford the contest, and the victory goes by default to the wealthy ranchman or the well capitalized company. The doctrine of riparian rights even as modified by fifty years of court decisions, is hopelessly inadequate, and the water users have had to resort to private agreements with mutual recognition of all the rights appurtenant to the supply in question. The doctrine of appropriation, the only doctrine suited to an arid agriculture, has never been formally recognized in California, much less the superior right of the public to the water supply which is precipitated on the mountain heights, collected in state-owned lakes and rivers, and which is indispensable to the future development of the commonwealth.

By 1875 all the easily irrigated lands of the Cordilleran area were occupied and it had become evident that the homestead law which had worked so satisfactorily in the Mississippi Valley, was quite inapplicable to the conditions presented to the settler in the arid regions. The Desert Land Act was passed (1877) with intent to offer a sufficient reward to induce the man taking up public land to put in irrigating works. A full section of arid land, four times the amount permitted under the preëmption or homestead acts, might be acquired by paying twenty-five cents per acre at the time of entry, redeeming the same by irrigation, within three years, and then paying the final charge of one dollar per acre. Residence on the holding was not required.¹

The Desert Land Act was put through Congress by men who knew little of western conditions, on the assumption that water would always be found upon the land and in such form that it could be readily diverted to the fields; but few regions are so fortunately situated. Irrigation on a scale necessary to utilize distant mountain streams or to pump the subterranean flow, required more capital and engineering skill than the ranchmen possessed and usually developed a capacity for watering tens of thousands of acres. The organization of irrigation companies followed. Hydrographic engineering was a new art, construction was not infrequently faulty, water rights uncertain, and the quantity of water available often grossly exaggerated. The

¹ The act was amended in 1891, reducing the holding to 320 acres and introducing the residence requirement.

promoters of these schemes relied on the fact that the settlers could do nothing toward completing their titles without water, and they devised contracts by which the farmer paid a flat rate per acre, regardless of the amount of water furnished. The temptation to contract to irrigate more land than could be provided for proved irresistible, and many of the settlers were ruined. Such promoters soon discovered, however, that they had killed the goose that laid the golden egg, for without water-users there could be no revenue.

The decade of 1880 to 1890 was the boom period of irrigation. The energies of the West were turned from the dwindling returns of cattle ranches and mining properties to the latent possibilities of the desert. Speculation ran riot. The capacity of lakes and streams was over-estimated, and the agricultural value of land and climate exaggerated by over-enthusiastic promoters; stocks and bonds were sold broadcast among investors who appreciated the significance of irrigation, but had no means of testing the legal or financial status of any individual proposition. The great majority of these projects failed and the money contributed by thousands of small investors was irretrievably lost. Nothing goes to wreck more quickly than irrigation works where repairs are not maintained; the ditches fill with sand or silt, the flumes warp in the sun, and the cement dams disintegrate under the alternate action of frost and heat. Many of the promoters, as well as the investors, had reason to ask themselves the unanswerable conundrum, what is the difference between a boom and a boomerang.

Of far more interest than the physical problems of irrigation or its speculative possibilities, is the slow but steady growth of custom and legislation away from the doctrine of riparian rights and priority claims to the recognition of the paramount importance of beneficial use and the public good. The first scientific study of irrigation as an economic problem was made by J. W. Powell, Chief of U. S. Geographical Survey, in his report on the *Lands of the Arid Region*, published by the Government in 1879. Powell had spent a decade in the exploration of the great desert region between the Colorado River and the Snake, and his conclusions were worthy of consideration. He estimated that eight per cent or about 60,000,000 acres of the Cordilleran area, was both fertile and susceptible of irrigation, a conclusion not greatly in excess of the latest calculations of irrigation experts. Since the

isolated farmer was unequal to the task of building and maintaining the dams and ditches needed, Powell proposed that Congress "authorize the organization of irrigation districts by homestead settlements upon the public lands requiring irrigation for agricultural purposes". Any nine or more persons applying for a tract of land with the intention of constructing irrigation works, were entitled to register for eighty acres each, in a continuous tract, the lands to be patented when evidence of successful irrigation was submitted. His observation of irrigation in Utah convinced Powell that a coöperative undertaking of this nature was not only practicable but the best means of preventing land monopoly, and he deemed such legislation essential "if these lands are to be reserved for actual settlers, in small quantities, to provide homes for poor men, on the principle involved in the homestead laws". Thus early was attention called to the inadequacy of the Desert Land Act, the desirability of encouraging a more democratic form of irrigation by coöperating communities, the necessity of attaching the water right to the land in order to guard against monopolization of both land and water, and the importance of a scientific classification of the public lands into irrigable, pasture, timber and mineral, so that the diverse interests might be promoted by appropriate legislation. Powell was, unfortunately, twenty years in advance of public sentiment, and his farseeing recommendations attracted little attention at Washington.

What might be accomplished by coöperative effort had already been demonstrated in the Mormon communities and in the Union Colony at Greeley, Colorado; but the first legislative enactment in furtherance of coöperative construction was the Wright Act, the California law of 1887. This provided that irrigation districts might be organized under state supervision wherever a majority of the resident freeholders should petition for the privilege. The district, once established, had authority to issue bonds, secured by a mortgage on the lands in question, for the purchase or construction of water-works, and further, to levy taxes assessed on the real estate represented sufficient to meet interest on the bonds and the annual costs of maintenance. The conduct of routine business was vested in elected trustees, but extraordinary contracts must be submitted to vote and ratified by the freeholders. Extravagant hopes were entertained of this system, and many districts were organized, but few have proven entirely successful. In many instances worthless or contested water rights were purchased, and

the district was involved in long and costly litigation. In others, engineering works of great difficulty were undertaken with small comprehension of the expense involved, and the original bond issue was swallowed up in the preliminary works. In order to get the water within reach of the farmers, a new issue was made necessary, and the trustees found the marketing of second mortgage bonds on property as yet undeveloped a piece of financiering quite beyond their powers. In the effort to push the enterprise through to completion, they not infrequently resorted to illegal means, and the district was in consequence dissolved. The crisis of 1893 involved in financial ruin still other districts that had been successfully managed up to that time.

Some of these difficulties were peculiar to California, where confusion as to water rights and the hostility of private companies presented well-nigh insuperable difficulties, but others are universal. It is not an easy matter to get a group of landowners, geographically selected with reference to drainage basin, to coöperate intelligently and to wait patiently the result of an engineering problem; and again, the resources of such a community are rarely adequate to the carrying through of any but the simpler works. The irrigation district has since been legalized in half a dozen western states, and many bankrupt companies have been bought out by farmers thus associated; but nowhere is the device regarded as the solution of the larger financial problems of irrigation. The irrigation district can only succeed where cost of construction is light, and where soil and climate render the lands highly productive, as in southern California. Western men were becoming convinced that if the homestead law was to have any meaning west of the hundredth meridian, government must come to the aid of the settler, first in the adjudication of water rights, and second in the construction of the more costly irrigation works.

Under the influence of Greeley and its daughter colonies, the state of Colorado (1876) had set aside the riparian right and announced the doctrine of appropriation, dedicating the water of every natural stream to the use of the people. A brief experience of the hardships and loss involved in water wars and law suits determined the farmers of Colorado to insist on the public adjudication of conflicting claims. The state is now divided into districts according to drainage, and disputes as to priority and the pro-rating of water are referred to the corresponding water commissioners, from whose decision the aggrieved may appeal to the

courts. But Colorado has as yet made no provision for the scientific measurement of the flow of streams, the capacity of canals, the acreage of land served, and the agricultural duty of the water furnished. The early settlers were accustomed to put in claims for a water supply far in excess of their needs, and the sum total of these claims was often in excess of the maximum output of the stream. The important water resources of the state are thus pledged to two and three times their utmost capacity, and the land now being developed can only be provided with water by the construction of mammoth reservoirs. Colorado, however, took the lead in adopting the principle of appropriation as fundamental to any final adjudication of water rights. This doctrine and the necessity of public control were soon recognized in Congressional legislation (e. g. the Desert Land Act and the Timber Culture Act), and these principles may be regarded as now fully established for the arid region.

The water code of Wyoming, adopted with its constitution in 1890, was the first thorough-going attempt to put the vexed question of water titles on a scientific and equitable basis and to render the water right inseparable from land ownership. Under this law, application for diversion of any portion of a lake or stream must be registered with the state engineer, and no claim has any validity until ratified by his office. The registration of a claim gives prescriptive right, but to secure legal title, the claimant must prove that the projected works have been constructed within the specified time and that the water is being used for a beneficent purpose. The state engineer is obliged to reject the application and to refuse registration in case the flow of the stream in question is all appropriated, or if he has reason to believe that the claimant is financially unequal to its development. Otherwise the certificate of registration might be used to promote a fraudulent undertaking. The adjudication of disputes is vested in a Board of Control made up of the state engineer and the superintendents of the four water districts. Evidence as to the capacity of the stream and of the several diversion ditches, together with the agricultural requirements of the lands to be furnished, are ascertained by scientific survey. The superintendent of the division in which the disputed claims lie, hears testimony as to priority of use, quantity utilized, etc., and prepares a list of existing claims. The decision of the Board of Control amounts to a formal decree defining all rights, and on this basis certificates of title are issued. Appeal may be

made, however, from the Board of Control to the courts. This comprehensive and highly satisfactory system has been adopted with various minor modifications in Nebraska, Idaho, Utah, Nevada, the two Dakotas, Oklahoma, New Mexico, and Oregon, and has gone far to straighten out the confused tangle of riparian rights, priority rights, excess claims, etc. The Wyoming plan has done all that law can do toward determining the legal status of irrigation in the commonwealths adopting it, and the practice of enforcing unauthorized claims by armed gangs and dynamiting the dams of rival companies is fast fading into the dramatic if disastrous past.

The legal problems of irrigation are thus in a fair way to settlement, but the financial problems remain. The furnishing of water by a private monopoly is no more satisfactory to an agricultural district than to a municipality, and the danger of inadequate supply and exorbitant charges is no less a menace. In southern Spain, where this system obtains and water is sold at auction, the water rates mount in a dry season to an all but prohibitive point. In a wet summer, on the contrary, when the farmers have no need of the artificial supply, they fall so low that the company does not realize enough revenue to offset running expenses. The California law of 1862 empowered water companies "to establish, collect and receive rates, water rents or tolls, which shall be subject to regulation by the board of supervisors of the county or counties in which the work is situated, but which shall not be reduced by the supervisors so low as to yield to the stockholders less than one and one half per cent per month on the capital actually invested." This method of adjusting charges has not proven entirely satisfactory to either producer or consumer of the water supply. Eighteen per cent, a not unusual rate of profit in the early days of California, is excessive now that there is abundant capital on hand for such investments, while the "capital actually invested" means an overestimate of the present value of the property. No redress was provided in case the supply furnished is insufficient to meet all engagements, and in the not infrequent cases where the canal crosses county lines, the several boards of supervisors may come to different conclusions as to the justice of a given rate. Finally, the courts have ruled that a contract negotiated between company and water-user cannot be set aside by the dictum of a public officer, and many farmers have been induced to accept a

“contracting-out” clause which renders the arbitrament of the supervisors invalid. However, in the last analysis, the prosperity of the community served is recognized by sane promoters to be the ultimate source of revenue, and charges are regulated by what the farmer can afford to pay rather than by what the water monopoly might possibly extort, while in many districts the water works are owned and rates fixed by the farmers themselves.

On the other hand the financial future of the irrigation company is often far from reassuring. Irrigation works are usually built in advance of settlement, and returns sufficient to pay interest on the cost of construction cannot be expected until the number of consumers has reached the full capacity of the flow. Even where all conditions are favorable, water abundant, works adequately built, and soil and climate promising, the promoters of water companies aiming to supply settlers on public lands are often balked of dividends by the “sooners”, who seek out each new project in advance of the constructing engineers and locate their claims as soon as the surveyors’ stakes are driven. By more or less fraudulent compliance with the homestead act, they manage to get possession of the best land under the prospective canal. They have no intention of developing their holdings and use little or no water for irrigation, but hold their patents for a rise in value and thus retard legitimate settlement. An arrangement far more satisfactory both to the farmers and to the purveyor of water obtains where both land and water supply are owned by the same company. Thus the Crocker estate in the San Joaquin valley is being sold in small tracts of five, ten and twenty acres to actual colonists, and the deed of sale guarantees sufficient water for irrigation at the flat rate of one dollar per acre per year. The same terms are accorded under the Miller & Lux irrigation project and on some of the great California wheat ranches that are now being divided into fruit farms. The system is an admirable one, ensuring to the cultivator the indispensable water supply at a reasonable and unvarying price and to the owner of the works an adequate return on his investment.

Long and intimate acquaintance with the vexations that beset irrigation projects inspired Senator Carey of Wyoming to urge upon Congress the legislation which has finally put the private irrigation of public lands on a rational basis. Under the Carey Act (1894), the federal government offers to make over to any one of the arid states complying with certain provisions as to

reclamation and settlement, one million acres of the public land or such portion thereof as has been demonstrated by actual survey to be susceptible of irrigation. The land commission of the state participating in this privilege is made responsible for the projects undertaken. The adequacy of the water right, the character of the works, the financial standing of the undertaking company, are all passed upon and the prescribed specifications accepted in a written contract before the lands covered by the project may be offered for sale or advertisements issued. The lands are sold by the state officials in tracts of from twenty to one hundred and sixty acres, at a rate fixed by each state and to bona fide settlers.² Persons filing on these lands must furnish proof of at least thirty days residence and the cultivation of one eighth of the tract before receiving clear title. Furthermore, they must have signed a contract with the water company agreeing to purchase the water right at a specified charge per acre. Ten years is allowed for the water right payment, but this obligation may be anticipated or passed on with the title in case the holding is sold to a later incumbent. The settlers are purchasing not water only but the irrigating system. The price put upon this perpetual possession varies according to the exigencies of construction from twenty-five to fifty dollars per acre, estimated on the supposition that, all the lands being taken up, the returns will cover the cost of the works and a fair profit on the investment. The capital once recovered, the promoting company proceeds to a new venture, leaving the settlers owners of the works. The water rights are converted into water stock, and a water-users' association is organized in which the farmers hold stock in proportion to their respective acreage. This coöperative company, like the irrigation district, is responsible for the maintenance of canals, the distribution of water, and for any repairs that may prove necessary.

Idaho inaugurated the Carey Act system with signal success, and the sage brush plains of the Snake River Desert were brought under cultivation with marvelous rapidity. The example of Wyoming and Idaho was followed by Montana, Utah, Colorado, Arizona, California, and New Mexico. The achievements of irrigation under the Carey Act have been highly gratifying to its sponsors, and the guarantees provided have given to this class of irrigation securities a recognized financial status. The farmers' water right

² Oregon makes no charge for the land but requires the cultivation of one fourth the area.

contracts, secured by a first mortgage on the land, are deposited as security for bonds issued in the ratio of one and a half to one, the annual payments are collected by the representatives of the bondholders and applied, year by year, to meet interest and the ten annual payments on the principal; but the value of the irrigation system as appraised by the state engineer is the ultimate security. Notwithstanding these precautions, a Carey Act project may fail to fulfill its obligations, in case it is unable to market bonds sufficient to complete the works, or the difficulties of construction prove unexpectedly great, or untoward floods carry away the dam and costly repairs are necessitated. It is evident, furthermore, that the ultimate source of revenue is the earning capacity of the lands under the project. If these are not rapidly taken up, or if the conditions of soil and climate are such as to render tillage unremunerative, water right payments will not be forthcoming, and the only asset recoverable may be a discredited irrigation system and the underlying lands. The recent collapse of the Conrad Land and Water Company, and the Big Lost River Irrigation Company, which went into the hands of receivers with outstanding bond issues of \$150,000, and \$1,355,000 respectively, are cases in point.

National interest in the reclamation of arid lands culminated in the Reclamation Act (1902) whereby the proceeds of public land sales, in excess of the educational obligations already assumed, are devoted to the reclamation of agricultural lands in seventeen arid and semi-arid states. The Reclamation Service was organized under the Department of the Interior, and surveys and engineering estimates were undertaken by some of the ablest hydrographic experts the country afforded. The location of projects has been somewhat determined by the requirement that the major portion of the funds arising from the sale of public lands should be expended ultimately in the development of irrigation in the state from which they were derived, but it has proved impracticable to observe this rule.³ The state of North Dakota, which ranks first in order of land sales, falls to the thirteenth place in point of expenditure. Oregon, which stands second in receipts, ranks eleventh in amount of expenditure, and the discrepancy is hardly less marked in the case of Washington, Oklahoma, and South Dakota. Arizona on the other hand, which has received

³ Section 9 of the Reclamation Act stipulating such distribution of funds was repealed June 25, 1910.

the largest appropriations for irrigation works, ranks thirteen on the score of income. Need and not revenue has become perforce the criterion of apportionment. During the eight years of its existence, the Reclamation Service has undertaken and brought to the stage where the lands are open to registration thirty-one projects; \$60,000,000 has been expended, 1,000,000 acres of arid land have been brought under cultivation, and \$1,500,000 has been paid on water rights. According to the provisions of the Reclamation Act, entry on the lands redeemed must be made under the Homestead Law, and for tracts of not less than ten nor more than one hundred and sixty acres, as shall be determined adequate for the support of a family by the engineers in charge of the particular project. The acreage charge for perpetual water right varies with the cost of construction, but averages less than the Carey Act charge because the government makes no allowance for profit and loss. The charges are to be paid in ten annual instalments, the first of which must be paid on filing. The settler must prove that half his land is under cultivation, and all of the annual water right payments must be met, before he can get his entry patented. No commutation of the five years' residence is permitted under the Reclamation Act.

Opposition to the Reclamation Service on the part of irrigation promoters has been widespread and persistent. This government venture is quite naturally regarded by men with capital to invest as an unjustifiable infringement on the field of individual initiative. But the legitimate field of private enterprise is largely preempted already. There were approximately 20,000 acres of land under irrigation in 1870 and 1,000,000 in 1880. The census of 1890 showed 3,631,381 acres with an artificial water supply, and that of 1900, 7,263,273. The rate of increase has been declining, in part because the limit of our resources in the way of land and water is in sight and ditch building has outrun settlement, and also because, as the snares and pitfalls of irrigation investments come to be understood, capital is less easily obtained. Only the reassuring propositions of the Carey Act saved this type of business from complete collapse after the panic of 1893. Further, much of the reclamation work remaining to be done is beyond the scope of private enterprise. The federal government alone is able to undertake construction on the scale necessary to convert the great interstate watercourses such as the Missouri, the Big Horn, the Yellowstone, the Snake, the Grand, the Green, and the

Colorado, to their highest efficiency as irrigating systems; some intra-state resources, such as the Salt River, present engineering problems of first magnitude, while the task of conserving flood flow in reservoirs is barely broached. These latent possibilities, moreover, dominate large areas of public land, the national heritage which the government is bound to place at the disposition of the people. The maintenance of a policy calculated to preserve to the republic the type of citizen farmer created by the Homestead Act, may be urged on weighty political and social as well as economic grounds. In view of a long future, whose prosperity is dependent on the well-being of the plain people and the normal development of farming communities in regions hitherto waste, the government can afford to wait decades for returns on capital invested, water right charges can be gauged by what the settler can afford to pay, and considerable lee-way allowed before cancellation of entry. A private company would be ruined by so generous a policy.

We have had sufficient experience of irrigation under the two Congressional enactments to enable us to reach certain conclusions as to the economic problems arising in this new field of agricultural experiment. It has become quite clear that the irrigated farm is not a poor man's proposition. The process of converting the desert into a garden may appear like legerdemain in "before and after" photographs, but in actual experience it is a slow, laborious and costly affair. The land is the least expensive factor in this situation. The indispensable water right is purchased at from ten to ninety dollars per acre; the annual cost of keeping up the canals amounts to from one to three dollars per acre, while the grading of the soil and the construction of laterals and ditches calls for a considerable additional outlay. The Reclamation Service recommends that a man undertaking to homestead under one of its irrigation projects bring with him \$2000 to lay out in buildings, stock, and living expenses for the first year or two while the tract is being cleared and graded and made ready for crops. It takes some years to determine what crops are best suited to each variety of soil and climate and for what products a profitable market can be had. On several of the government projects, the Department of Agriculture maintains an experiment station, but even more important to the economic success of the farmers is the service of the project engineer. As soon as the work of construc-

tion is accomplished, the hydrographic engineer is succeeded by a man experienced in the problems of soil and climate, the duty of water and the possibilities of cereals, fruits and vegetables; who has, moreover, sufficient knowledge of human nature to fit him to deal patiently and wisely with the mistakes and discouragements of the novices in irrigation with whom he has to deal. The government has sent some of its best trained men to oversee these reclamation experiments.

The relative merits of the two methods of irrigating the public land now authorized by the federal government may be studied on Snake River, where an area of one million acres is being brought under irrigation, half by private companies operating under the Carey Act, and half by the two government projects of Boise-Payette and Minidoka. The settlers under the Twin Falls Land and Water Company are largely men of some property who have been able to secure their patents within the minimum term, while keeping up water payments of twenty-five dollars per acre and developing their holdings into flourishing little farms. After securing title to his homestead, the Carey Act farmer may mortgage the land for money with which to make permanent improvements, or, if climate and environment prove unsatisfactory, he can sell to advantage, assigning his water contract to the purchaser, who assumes the unpaid instalments. Nearly all the Twin Falls settlers have "proved up", and there has never occurred a cause of failure to meet the annual charges, nor has a single contract been forfeited for arrears.

The Minidoka Project illustrates the virtues and defects of the government method as compared with those of a private company. The long-term residence prescribed by the Reclamation Act is a serious obstacle to enterprising men, far outweighing the fifty cents an acre charge for the state lands, and homesteaders who have means to meet the cash payment gravitate to Twin Falls, notwithstanding the superior quality and lower cost of the government water-works. The charge for perpetual water right at Minidoka, determined by the bare cost of constructing and maintaining the irrigating system, is \$22 and \$30 per acre. The farmers do not come into possession of the works, as under the Carey Act, and this seems, at first blush, an injustice; but community management has its difficulties and dangers. Under the Reclamation Service, the water-users' association must pay for the maintenance of the canals and the distribution of the water, but

the dams and the reservoirs remain the property of Uncle Sam, and he is responsible for their integrity. This principle will probably be extended to the electric power developed at the government dam. The current is used for the benefit of landowners under the project (the charge for private lighting is one half a cent per kilowatt hour); but the water-users are responsible only for its economical and equitable distribution. The advantage of having the Reclamation Service assume deterioration charges for these costly plants is evident.

When I visited Minidoka in the summer of 1907, the settlers were complaining that the government was pretty slow, and there is no question that the promoters of the Twin Falls project were rapid by comparison. It is to the interest of a private company to push the work through to completion, collect the payments, and free their capital for a new enterprise, whereas the Reclamation Service engineer cannot work more rapidly than the revenues derived from public land sales will allow. The total receipts turned into the Reclamation Fund for 1907 were a little less than \$8,000,000, and this sum had to be divided among thirty-one different projects. Minidoka's allotment for 1908 was but \$70,884, not enough for the installation of the pumping and power machinery and the building of the lateral canals needed to conduct the water on to the farms. By consequence, hundreds of settlers who filed when the tract was first opened for entry in 1904,⁴ and who had brought half their claims under cultivation according to requirement, were still without water. Some raised crops of wheat and potatoes by dry-farming methods, others, who were blessed with the wherewithal, put in windmill pumps; but it was a long, discouraging pull and many had fallen by the way. About half of the early settlers were still clinging to their hard-earned claims, but there were numerous "relinquishments" and new comers had bought in the lapsed homestead rights. When in the spring of 1908, the authorities announced that water would not be available for the south side lands for another year, the people were at the limit of their well-worn patience. But the project engineer, came to the rescue with a brilliant idea. He proposed that all the government money should be devoted to the necessary power and pumping machinery, while the farmers

⁴The Act of June 25, 1910, forbids the taking up of land under a government project before the Secretary of the Interior has published the water-right charge and the date when water can be furnished.

should build the connecting canals. The plan also provided that the Secretary of the Interior would pay for the labor of men and teams in "water-scrip" receivable in payment for any and all water rights. There is no man more conservative and individualistic than your well-seasoned farmer. It was not easy to persuade a body of thoroughly disheartened men to go into a coöperative scheme based on confidence in each other and in the government.

But the project engineer had full faith in the method and his enthusiasm was contagious. The water-users' association was organized, contracts for earthwork and excavation were given out in sections feasible for the farmer and his team, larger bids were rejected and sub-contracting was not permitted. Six hundred men set to work on April 17th, with an energy born of despair. The three "bench" canals, ninety miles in all, and the principal sub-laterals were completed by June 23rd—in less time than professional contractors had estimated the work could be done. It seemed a stroke of genius. Labor that was running to waste was brought to bear where it was most needed, and the farmers were enabled to forestall their obligations to the Government in their one available asset. No money need be sent to Washington to meet the water right instalments as they fell due, draining the region of its much needed cash. Meantime, the water-scrip was accepted by bankers and local merchants and served to pay for immediate necessities. It had been taken at a slight discount, but there was every reason to suppose that when the first water payments came due, and the scrip began to be redeemed, it would circulate at par. To be sure, certain eastern senators, held to be authorities on "emergency currency", protested the whole scheme on the ground that the Reclamation Service was issuing a form of paper money; but the device was approved by Secretary Garfield, and adopted in half a dozen more government projects where a similar situation had arisen. Some \$300,000 in water-scrip for work on the various irrigation projects was in circulation when, like a bolt from the blue, came Attorney General Wickersham's decision that the issue was illegal, since not specifically authorized by the Reclamation Act. The financial foundations of these struggling little communities was suddenly called into question, and the whole service was disheartened by the uncertainties of the law. The water-scrip has since been redeemed at par (March 1910), and the issue of \$20,000,000 in bonds against future revenues from water right payments,

authorized by Congress in accordance with the recommendation of President Taft, will make possible the completion of the works already under way. The army engineers, appointed to investigate the several undertakings and apportion the fund, have divided it among the fourteen projects where large expenditures are still called for, leaving the remainder to be provided for by land sale receipts.

The wisest and most experienced of the project engineers are agreed that the chief difficulty of the farmer on the government projects is lack of capital. Under the restrictions of the Reclamation Act, the homesteader cannot secure a title to his land until the expiration of the five year residence term. The commutation clause of the Homestead Law by which patent might be secured on payment of the government price of \$1.25 per acre, was expressly excluded from the Act of 1902. Under these conditions the settler cannot borrow money on his holding during the initial years when his need is greatest. Mr. Thomas H. Means, until recently project engineer at Truckee-Carson, has made a study of the relinquishments among the 544 homesteaders who filed under that project, and his conclusions are based on a personal acquaintance with most of the entrymen. The number of cancelled and relinquished entries was 238 or almost half the total filings. Of the failures, 180 or 67 per cent were men and women who had filed in the spirit of speculation, with no intention of building a home, but in the hope of selling out their claim to some later comer. From such settlers no genuine effort to make a success of irrigation could be expected. Of the 327 bona fide homesteaders, 88 have relinquished their holdings, and 96 are likely to fail, leaving only 143 or 43 per cent in the successful class. In searching for the causes of failure, Mr. Means sets down 4 to lack of experience, 23 to adverse conditions—sandy or alkali soil, inability to get water in time to save crops, etc., and 34 to lack of capital and 35 to plain discouragement. It would seem that 71 per cent of the failures are due to conditions arising out of the long residence requirement. In the unpublished paper from which he permits me to quote, Mr. Means states: "The residence clause is one great stumbling block. A settler is required to move his family on his homestead within six months after his filing. He brings his family out to the sun-blistered desert without shade or grass, and this often does much to discourage his wife and his family. Could this man carry on his

improvements and let his family live in town or back east, he could accomplish more and suffer much less hardship. Improvements should be made the test, not residence." Again: "If a settler could obtain some form of title to his place more promptly and so have something on which he could borrow money, he would often make good where he now fails. In reclamation projects, the government would want to retain the first mortgage until the water right was paid for, but the second mortgage owner could at any time remove the first mortgage by paying up the water right charges." The clause in the Reclamation Act requiring "actual and continuous" residence for a term of five years was intended to guard against dummy filings, speculation and the accumulation of large estates—to reserve this last and richest portion of the public lands for the genuine farmer. But the bane of *latifundia* is less to be dreaded on irrigated lands, where intensive farming is alone profitable, than in a grain or cattle region. Congress has made the long-term residence requirement absolute just where it is least needed. If the commutation permissible under the Homestead Act were allowed, and a man might pay down the statutory price of the land, the position of the homesteader would approximate that of the settler under the Carey Act; but even more effective would be Mr. Mean's suggestion that the residence requirement be dropped or abated and that salable title be given as soon as a certain amount of improvement has been made. In this way the man with small capital but possessing those more valuable qualities of brains, pluck, and endurance, would be enabled to earn a farm by the labor of his hands, as truly as did his forbears in the humid states east of the Missouri River.

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